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Walter A. Anderson, State Geologist

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Title: Reconnaissance Surficial Geology of the Sebec, Schoodic, Lincoln, and the Southern Portions of the Jo-Mary Mtn., Norcross, and Millinocket Quadrangles, Maine

Author: Galen Kenoyer

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Contents: 6 page report

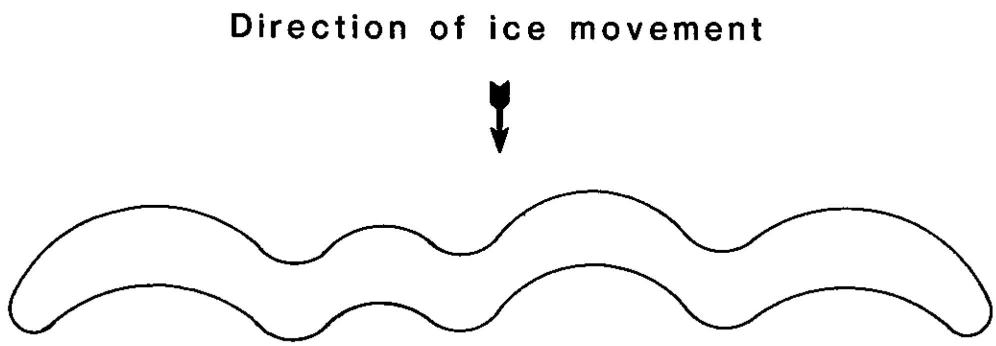
Till

The till in the study area is extremely variable in texture. It ranges from sandy ablation-type till that is relatively well sorted to silty "basal" till that is very poorly sorted. In the northwestern part of the field area nearest Mt. Katahdin, the till is very coarse, with a sandy matrix derived from rotten granitic boulders, probably from Katahdin. In this case the texture is largely determined by the coarse rock. Sometimes it was very difficult to distinguish between glaciofluvial deposits and "water-laid till", till that shows some evidence of deposition in water. These water-laid tills, which include flow tills and ablation tills, often exhibit some degree of stratification. Thin lenses of water-worked silt, sand, and gravel separate till layers. These lenses are oftentimes folded, showing evidence of slumping or overriding. The presence of a sufficient number of striated, faceted and polished stones in a deposit was taken as an indication that the sediment was deposited chiefly by glacier ice and not water. This served as a criterion for differentiating tills from glaciofluvial deposits when the texture was not distinctive.

Loose "ablation" till and compact "basal" till occur in close proximity, and appear to be influenced by topography to a large extent. Looser ablation till more often occurs on the downstream side of hills or mountains but many exceptions occur (e.g. drumlins where the till is often compact throughout). "Ablation" till occurs above "basal" till in outcrops where 2 tills are exposed.

Till occurs as ground moraine, drumlins, Rogen moraines, and rarely as end or lateral moraines in the field area. Drumlins were mapped using Flint's (p. 101, 1971) definition: The ideal drumlin approximates half an ellipsoid in form...with the long axis paralleling the direction of glacier movement and the transverse axis situated upstream from the midpoint of the long axis. "Ideal" drumlins constitute a standard form from which individual units depart widely. Proportions range from nearly circular to a length/width ratio of 50:1. Drumlins may be composed entirely of till, usually clay-rich and compact, or partly sorted and stratified drift overlain by till. They often have a bedrock core and may be composed "almost entirely of bedrock discontinuously veneered with till" (Flint, 1971, p. 103).

An unusual type of moraine occurring in this area is known as a Rogen moraine, named after its type locality in Sweden (Lundquist, 1969). It has also been described as ribbed moraine in northern New York (Carl, 1978), rippled till in Labrador (Ives, 1957), and hummocky moraine in western Canada (Gravenor and Kupsch, 1959). These features consist of subparallel moraines up to 30 meters high and 100 meters wide oriented transverse to ice movement. In well-developed moraine areas, the distance between ridges is about the same as their width. Within any tract of moraines, the dimensions of individual moraines are quite uniform, but dimensions can vary widely from one tract to another. The ridges are often quite irregular, winding, and anastomizing. When fully developed, they are composed of many smaller arcuate shaped ridges with the concave side in the direction of glacier movement.



Composition of the Rogen moraines varies from almost complete basal till to loose ablation till with some stratified segments (Lundquist, 1969) (see Fig. 9 & 10, p. 22, 23). Most often there is a compact till segment overlain by stratified sediments and/or ablation till.

Rogen moraines occur in the northern half of the field area and exist as far south as South Branch Lake in Seboeis. Outside the field area, they occur as far north as Mt. Katahdin. They occur in lake basins or valleys and may grade into drumlins in the hills or become hummocky in the valleys. Their composition is chiefly loose sandy till with some discontinuous stratified sediments scattered throughout. Striated, faceted, and polished stones are common in the till. Boulders up to 2 meters in diameter occur within the moraines.

In areas of undulating topography, transitions from drumlins to Rogen moraines have been described (Lundquist, 1969, Fig. 25, p. 14). The northern part of the field area between South Twin Lake and Cedar Lake contains moraines of this type of transitional morphology (see photo ETR 15, 71-75). There are also transitions to hummocky dead-ice moraines. In these areas, the parallel nature of Rogen moraines is evident but there is a hummocky irregular nature also (Lundquist, 1969, Fig. 6, p. 17). The area around Mattamiscontis Lake is an example of this type of terrain (photos ETR 17, 184-188).

Several observations support Lundquist's hypothesis that Rogen moraines are subglacial deposits: they sometimes grade into drumlins; they do not lap over eskers but end abruptly when nearing the eskers; they are of fairly uniform size within any group of moraines; they contain striated stones. Rogen moraines are probably formed in response to subglacial tension on active moving ice in basins (Lundquist, 1969, Fig. 11, p. 25). The preservation of the rather fragile structures, however, probably requires dead-ice disintegration (Lundquist, 1969, p. 30). This hypothesis receives support in the fact that stratified sediments and ablation till are often superimposed on the subglacial morphology.

Thus Rogen moraines "should be considered a subglacial deposit of active ice, the preservation of which demands dead-ice deglaciation, and the situation of which is topographically determined" (Lundquist, p. 30, 1969). This information may be valuable to reconstructions of the Late Wisconsin ice sheet in Maine.

No lateral or end moraines were observed in the field area with the exception of 2 possible moraines of minor extent in Maxfield.

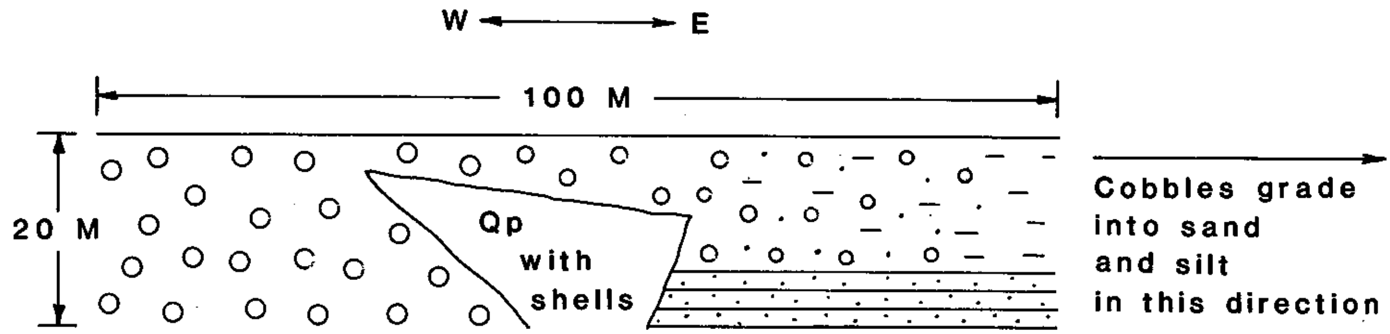
Glaciofluvial Deposits

Glaciofluvial deposits are prominent features in the field area. A series of eskers of the Katahdin system (Stone, 1899) drained the Katahdin region and extended in a south-southeast direction. Two large eskers merge at South Lincoln to form the Enfield esker, which then merges with the Hoytville esker in Greenbush. Another major esker enters the field area southwest of Endless Lake and becomes the roadbed for Route 16 at Lagrange. Smaller esker segments occur throughout the area, often serving as tributaries to the large eskers.

Sediment size ranges from silt to boulders up to 3 meters in diameter. The stratigraphy of many pits is shown on the progress maps of the area.

Small kames occasionally occur on the downglacier side of mountains in the area. It is likely that as the ice sheet thinned and the surface dropped below the peaks of the mountains, an eddy effect resulted in a depression in the ice surface on the back side of the mountain. This then became a deposition site for surface meltwater stream sediments, resulting in a kame deposit. Flow tills would also be deposited in these depressions. An example of this type of phenomenon is Mattamiscontis Mountain where small kames occur on the south side. In some cases they are capped with an ablation till layer.

Glaciofluvial deposits appear to rest on till in the few areas where a determination could be made. In a few cases, an ablation-type till layer capped esker sediments. Eolian sand blankets esker sediments in some areas. Marine clay sometimes caps the esker, while wedges of marine clay occur within esker sediments in some areas (e.g. on Route 16 in Alton).



This clay appears to be slumped, probably during ice wall collapse. It argues for ice front deposition of marine sediment, thus supporting Stuiver and Borns (1975) hypothesis that marine waters lapped against the edge of the retreating ice sheet.

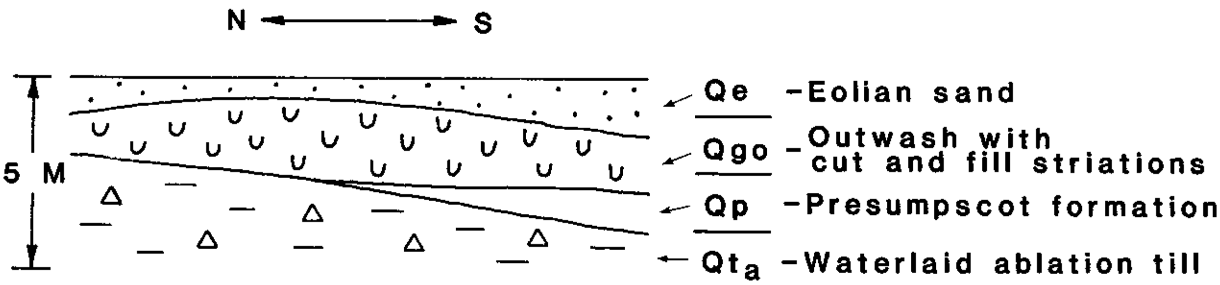
An interesting phenomenon occurs in Greenbush where the Hoytville esker turns 90° to the direction of ice movement to join the Enfield esker. Current cross-bedding in esker sediments at this location confirm that the flow direction was easterly.

Outwash

Most outwash deposits occur in the southern half of the field area. The textural characteristics of the outwash are essentially the same as for esker sediments, but the outwash deposits are flat lying rather than in a ridge shape. Some areas in Greenbush, Passadumkeag, and southern Enfield are mapped tentatively as outwash on the basis of the Soil Cconservation Service Soil Map of Penobscot County. Some data was used from this source in areas that were not accessible, and these designations should only be regarded as tentative.

There appears to be much less outwash in this area than in the West-Central Maine area mapped by Borns. Perhaps most of the outwash in this area has been eroded away by water and wind action.

An instructive pit on the east bank of the Penobscot River near Lincoln shows the following stratigraphy:



Elsewhere in this and other pits a sand layer lies beneath the Presumpscot Formation. This may be esker material or outwash. If it is outwash then it indicates that a time gap occurred between the retreat of ice and marine invasion, during which time outwash was deposited. Further field work may clear up this question.

Presumpscot Formation

The Presumpscot Formation is a glacial marine deposit composed chiefly of silt-sized sediment. It occasionally occurs as sand and gravel deposits, especially in former beaches. It is common in the low-lying areas of the Penobscot Valley region up to about 300 feet above sea level. It has been reported to extend as far north as East Millinocket where it was uncovered during the excavation of the Great Northern mill (H. Borns, pers. comm., 1978). The occurrence of the Penobscot Formation seems to stop abruptly at about 300 feet. I encountered numerous instances of low-lying areas that gradually extended to above 300 feet, but the clay seemed to disappear at the 300 foot contour or below. In some cases, dark brown to grey silty sediment occurred in swampy areas above 300 feet, but did not have the same characteristic grey-blue color of the Presumpscot Formation and thus was not mapped as such. It is conceivable that the Penobscot Formation occurs above 300 feet as coarser grain-sized sediment and, lacking marine shells, it could easily be mistaken for outwash, alluvium, or glacial-fluvial deposits.

The marine limit in this area appears to be considerably lower than in the west-central Maine area (H. Borns, pers. comm., 1978). The reason for the apparent lower marine limit in this area of the Penobscot Valley is not known.

The marine limit position in Maine is critical to the reconstruction of the late-glacial and post-glacial history of the Laurentide Ice Sheet and in the dynamics of ice-sheet disintegration. The calving bay mechanism, by which an ice sheet can disintegrate in a few hundred years, is closely linked to local sea level. The position of the marine sediment limit gives us the closest fix on the marine limit of submergence, providing valuable data points for the reconstruction of calving bays in Maine during deglaciation.

Two deposits of well-rounded, moderately well-sorted coarse sand and gravel had the appearance of beach deposits. They both occur on top of hills at about 260-270 feet and would have been well-exposed to wave action during the marine invasion. Both deposits lie upon till.

Shell samples were collected at 2 sites: K78-25, in clay within Route 16 esker in Alton; and K78-12, in clay on the Greenfield Road in Greenbush. Both are indicated on the topographic maps.

The Presumpscot Formation commonly occurs at the surface, blanketing underlying sediments, including till, eskers, and kames. Eolian sand frequently covers marine sediment in low lying areas near eskers or in river valleys. Clumps of marine silt are sometimes found within eskers also.

Eolian Deposits

Eolian deposits are common in the southeastern portion of the field area near the Penobscot River basin. They occur in 3 forms:

1. Longitudinal dunes--elongated ridges up to 5m. high by 20m. wide, oriented WNW-ESE (280^{o}), parallel to the prevailing wind direction at time of formation.

2. Transverse dunes--Subcircular, curved random orientation with respect to wind direction; approximately same dimensions as longitudinal dunes.

3. Cover sand--flat lying deposits, often thin.

The orientation of the longitudinal dune axis is exactly the same as that recorded by John McKeon in a 1972 U.M.O. M.A. thesis on eolian sands in west-central Maine, and indicates a dominant wind direction of WNW shortly after deglaciation.

The texture of these deposits is medium to very fine sand, and is very well-sorted. Color varies from almost white to chocolate brown.

The location of eolian sand deposits is usually nearby and east of eskers on the Penobscot River. This suggests that the source of sediment is esker and outwash material. Most dunes appear to be inactive at the present time except where excavated by man.

Eolian sands are generally exposed at the surface overlying marine clay, till eskers, or outwash. It is probable that they were deposited shortly after deglaciation in a tundra-like environment.

Alluvium

Alluvium deposits of silt, sand, and gravel are common along the Penobscot River and some of its tributaries. In some cases it is difficult to determine whether a sediment deposit is alluvium or a glaciofluvial deposit, especially along the banks of the Penobscot River. Flood data and morphology of the deposit was helpful in distinguishing between these sediment types. Alluvium is most important as a sediment type on islands and along banks of the Penobscot and Piscataquis Rivers.

Swamp Deposits

Swamp and bog areas were mapped in the field and by air photos and topographic maps. In a few cases the dominant sediment in swamps could be determined by digging into the muck, and this sediment was then mapped as till, esker, etc.

Bedrock

Bedrock outcrops were scarce in this area. The lack of major roads through large regions of the field area may be partially responsible for the scarcity of outcrops, as roads often cut through bedrock. A careful search of air photos supported my field observations that bedrock outcrops are quite rare in this area.

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